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Abstract: *»Erdbebenvorhersage im Japan der Okkupationszeit«.* In the span of the first few years after Japan's defeat in World War II, five of Japan's leading earth scientists came forward to warn the nation that major earthquakes would soon occur. They (almost) never did. This article focuses on those predictions to highlight the debates that shaped early postwar efforts in Japan to make scientists, and earth scientists in particular, guardians of the public's safety. It draws on multiple archival collections, participant accounts and popular media coverage to explore the tensions between individual scientists and newly formed, officially sanctioned bodies charged with coordinating earthquake prediction research. These tensions, I argue, reflect both a long-standing ambivalence within the field toward prediction's legitimacy, and the emergence of a new set of research and policy imperatives for Japan's earth scientists that privileged it. The legacies of the Occupation-era encounters with prediction include the 1962 publication of *Earthquake Prediction: Current Status and a Plan for Development,* the formation of the Coordinating Committee for Earthquake Prediction in 1969 and the passage of the Large-Scale Earthquake Countermeasures Act in 1978.

Keywords: Imamura Akitsune, Sassa Kenzō, Tsuboi Chūji, Wadati Kiyoo, Beno Gutenberg, Great Kantō Earthquake 1923, hazard mitigation, political history.

1. Introduction

In the span of the first few years after Japan's defeat in World War II, five of Japan's leading earth scientists came forward on separate occasions, and implicating six different locations, to warn the nation that major earthquakes would soon occur. They (almost) never did. This article focuses on those predictions to highlight the debates that shaped early postwar efforts to make scientists, and earth scientists in particular, guardians of the public's safety.

The significance that scientists, policy makers, and the public have assigned to earthquake prediction in modern Japan, whether as a legitimate research topic or as a reasonable investment in mitigating against hazards the future was sure to bring, has varied widely. We are arguably at one end of a long arc that began more than a century ago, when John Milne, Sekiya Seikei and others laid

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modern seismology's foundations in Japan and established prediction as one of its goals. The pursuit of the sort of timely, specific warnings they had imagined may be nearing its end. As models of how and why earthquakes happen have become more sophisticated, they have suggested that the pathways leading to seismic events may be complicated beyond the limits of successful prediction. Better instrumentation or more careful measuring protocols will not matter, if these analyses are correct. With a few possible exceptions, and barring paradigmatic shifts in technology or modeling, many scientists are convinced that research into deterministic earthquake prediction has reached a dead end. Such conclusions, and the realization that massive investments of expertise and money towards the pursuit of earthquake prediction in Japan have yielded no success stories – the 1995 Kobe earthquake and the March 2011 earthquake and tsunami struck without the sort of warning the nation's prediction apparatus was created to provide – have already produced one set of narratives about prediction's recent history that is quite cynical about the motives and practices of the scientists associated with it (Shimamura 2004; Shimamura 2008; Geller 2011). Those narratives are in tension with an older and larger body of work that relates the history of earthquake prediction in much more positive terms, as one of institutions and researchers committed to protecting the nation from harm. While these histories do acknowledge that prediction has remained elusive in practice, they describe the pursuit of that goal as a rational, scientific campaign to address a problem that would in time be solved. Even as estimates of how long it would be before prediction was reliable and accurate were pushed further and further into the future, the image of seismologists working at the cutting edge of technological innovation for the good of the nation, and as having devised the best possible strategies for preparing the country for the worst, were widely shared. In the late 1970s, government surveys revealed that roughly 60 percent of those asked believed that earthquakes could already be predicted; more than a quarter expected prediction to become absolutely possible within ten years (Naikakufu seifu kōhōshitsu 1978).

One of this article's goals is to answer straightforward questions about the timing and the science behind the flurry of earthquake predictions that followed the end of the war. Why were so many made in such a short period of time? Public warnings from Japanese earth scientists about increased short-term risk from earthquakes had up to that point been rare events. Even Imamura Akitsune, who was perhaps early twentieth century Japan's most prolific predictor of earthquakes, was responsible for only a handful of such warnings over the course of his entire career. For many years he was really the only scientist with standing in the field who made such claims in public. Although Imamura was among those who contributed to the postwar surge of warnings, the four other scientists who did so were newcomers to prediction. What explains prediction's sudden, simultaneous prominence in their work?

It also makes sense to ask what happened to prediction as a set of scientific practices and ideas after 1949. After Nakamura Saemontarō's attempts that year to warn the residents of Niigata of an impending earthquake, Japan's earth scientists seem to have abandoned earthquake prediction – at least as a set of public practices – just as abruptly as it had once been embraced. Why? Given that the methods and data the scientists had based their warnings on were so varied, it seems unlikely that a single failed forecast or discredited model could account for the collective turning away from acts of prediction that happened after 1949. Those scientists who had issued public warnings – Kyoto University's Sassa Kenzō among them – appear to have suffered no lasting damage to their reputations as a result of their actions. In the early 1960s, when prediction once again became a highly visible part of the work that Japanese seismologists did for the nation, the leaders of that initiative included many of the same men who had played public roles in the debates of the 1940s. Asked another way, why was prediction set aside in the late 1940s, only to be enthusiastically embraced by the field a decade or so later?

Answering those questions also brings into focus some of the tensions that have shaped how science and society have interacted around the management of risk and natural hazards in Japan, and arguably elsewhere (Hough 2010; Fan 2012; Clancey 2012). The series of Occupation-era warnings discussed below were both specific to particular locales and time frames and part of larger, increasingly visible discourses about the importance of science to postwar Japan's future. Shaped in part by the perception that the Allies' victory over Japan owed a great deal to their investment and faith in science and technology, the idea that both should play prominent roles in Japan's efforts to rebuild was widely shared. At the same time, and as the confusion that accompanied the earthquake warnings of the 1940s highlights, there was little consensus within the scientific community about how or when to communicate ideas and concerns to the public or to policy makers. Early state-led efforts to support earthquake prediction research masked significant divisions among the key actors over what constituted a valid prediction, for example, and over their responsibilities to share what they knew. As will be seen below, negotiations over funding, institutional rivalries and the legacies of past earthquake warnings played important roles in shaping Japan's postwar turn to prediction. Focusing on this admittedly unusual episode does useful work both by challenging histories built around prediction's seemingly inevitable emergence as the flagship of the nation's defenses against earthquakes, and by drawing attention to how prediction's past remains relevant.

2. Post-Surrender Japan: Some Context

The Allied Occupation of Japan lasted from shortly after the Empire's surrender in August 1945 until April 1952. Very few of the nation's institutions were left unchanged by the reforms and legislative initiatives launched during that period (although many of these changes were the result of processes already underway well before the Americans arrived) (Dower 1999). While the Emperor, the military, and democratization in general were the most visible targets of Occupation-era reforms, the structures and practices of Japan's scientific community also came under careful if somewhat episodic scrutiny. The histories of the Earthquake Research Institute at the University of Tokyo and of many of the earth scientists who shaped seismology in postwar Japan suggest as much. One way to think about earthquake prediction's emergence as a social and scientific problem is as one of many instances during the Occupation in which Japanese actors – mostly seismologists – and Occupation officials were caught up in multi-layered negotiations over research agendas, resources, and occasionally, ideologies. While this study is interested both in earthquake prediction as a phenomenon of the Occupation and in its trajectory across multiple eras in Japan's modern history, the context of the discussions and debates about prediction in 1947 and 1948 (and beyond) clearly matter a great deal.

For one thing, both the key actors in the debates over postwar earthquake prediction and their access to the public had changed significantly since the last time these issues had attracted much public attention, which had been in the mid-1920s. The most visible earth scientists in postwar prediction – Sassa Kenzō, Tsuboi Chūji, and Wadati Kiyoo among them – were relatively young members of an emergent second generation of leaders in the field. None had been directly involved in the field's earlier encounters with prediction, all were well-established in their careers, and all but Sassa had done their graduate training at Tokyo Imperial University.

Much as the actors had changed, so too had the channels through which information and arguments about prediction travelled. Postwar mass media offered many more pathways through which interested readers could be reached than had been the case in pre-surrender Japan. Occupation-era reforms had freed the press from many of the constraints that had limited its ability to challenge officialdom or to report unpleasant or potentially disruptive news, restrictions that had become increasingly harsh during the war, and had promoted the idea that one of journalism's new responsibilities was to serve the public, not the Japanese state. While there were many exceptions to these rules, especially where the actions of the Americans themselves were concerned (American censorship of the press was widespread and often arbitrary) Japanese newspapers and journals exercised very little apparent restraint when it came to coverage of earthquake prediction in the late 1940s. The postwar boom in the

publication of popular magazines devoted to science is further evidence that new channels for communication found an eager audience.

The Americans were themselves one of the audiences for coverage of earthquake prediction, both via translations of Japanese-language newspaper articles that appeared in *Stars and Stripes* and other English-language publications, and officially in the context of conversations with seismologists and reports on their activities. Most of the official American interest in earthquake prediction originated with staff in the Natural Resources Section of the Supreme Commander for the Allied Powers (SCAP) bureaucracy. Officers of the 43rd Weather Wing were also part of the conversations about prediction because of their involvement with the operations and long-term plans of the Central Meteorological Observatory. The reasons for the Americans' interest were in part structural, reflecting SCAP's mission to re-organize every aspect of Japanese science, and in part scientific. If Japanese scientists had found a way to predict earthquakes, the Americans wanted access to that knowledge.

Having the Americans involved meant several things for Japanese seismologists. First, the Americans held almost all of the cards that mattered when it came to decisions about how best to reorganize Japanese universities and research programs more generally. Many of those processes were still taking shape in 1947 and 1948, the height of the first postwar earthquake prediction "boom." Over the course of the summer of 1947, the Earthquake Research Institute (ERI), the Central Meteorological Observatory (CMO) and several other agencies and offices involved in the earth sciences were subject to thorough, critical reviews at the hands of SCAP bureaucrats. Caltech's Beno Gutenberg was brought to Japan by the Americans in mid-1947 to consult on the review. Gutenberg's recommendations formed the basis for proposals that later sought to re-define the core mission and responsibilities of the various earth sciences agencies. The Americans were particularly concerned about what many of them saw as significant overstaffing and inefficiencies within the earth sciences infrastructure. Because one of SCAP's overarching goals at this point in the Occupation was to reign in Japanese government spending (as part of its ongoing effort to stabilize the postwar economy), it was no secret that the Americans were looking for ways to cut budgets and jobs where they could.

From the perspective of the scientists and technicians employed at the ERI or CMO, American scrutiny brought with it considerable risk and uncertainty. The risks were personal as much as institutional. In those first few years after surrender, the consequences of losing one's job – even ones as poorly compensated as most research positions surely were – would likely have been devastating. Those involved in the negotiations with the Americans over the fate of the Institute and the Observatory would have been well aware of what was at stake, just as they knew too that at some level they were in competition with each other for scarce resources. The tensions between the ERI and CMO went back many years and had in fact resulted in not a little duplication of effort. They ran

separate instrumentation networks, seldom shared data, and collaborated rarely, all practices of which the Americans were well aware.

Finally, it was also true that the Americans could be sources of legitimization, and could promote research agendas of which they approved. One of Beno Gutenberg's contributions to the review of Japanese earth sciences was to speak on behalf of his Japanese colleagues, to vouch for their skill and professional standing, and to argue for their continued access to the resources necessary for their work. His comments on earthquake prediction too carried some weight, and almost certainly influenced the Americans' decision to provide at least limited support for research and coordination in that area, beginning soon after Gutenberg's departure from Japan. It is to developments in the summer of 1947, and to the first postwar debates over earthquake prediction, that we now turn.

3. The Nankaidō Earthquake and Beno Gutenberg in Tokyo

On 20 December 1946, a massive earthquake with an epicenter offshore of the Kii peninsula destroyed almost 40,000 homes in southeastern Japan, and left more than 1,000 of the region's residents dead or missing. The Nankaidō Earthquake came two years after the equally deadly December 1944 Tōnankai quake, which like the 1946 event involved a rupture of what were thought to be coupled segments running southwest to northeast along the Nankai Trough (Yamashita 2009). The Nankaidō earthquake was the first major seismic event of the Occupation.

News that Imamura Akitsune had predicted the Nankaidō earthquake surfaced in its wake. Imamura's long and storied career as a seismologist began in the late nineteenth century, when he was among the first Japanese trained in the field. His reputation, and the arc of his career, took shape around two episodes, both relevant to his role in postwar earthquake prediction. Very briefly, the first involved the publication in 1905 of an article by Imamura in which he warned readers that Tokyo was at risk of a catastrophic, major earthquake in the relatively near future. The point of that warning was in part to encourage residents and policy makers to take precautions and to think carefully about what an earthquake might do to a city as densely inhabited and as fire prone as Tokyo (Imamura 1905). Not long after the article went into print, Tokyo experienced a series of relatively minor, but noticeable earthquakes. The public's frightened reaction to these tremors – said to be fueled by the re-telling in various forms of Imamura's warning – was unusual in its intensity and persistence. In an effort to calm the city's nerves, Ōmori Fusakichi, Tokyo Imperial University's sole Professor of Seismology and Imamura's direct superior, published a lengthy article of his own in March 1906. *The Groundless Rumor of a Great Tokyo Earthquake* (*Tokyo to daijishin no fusetsu*) was clearly directed not just

at general misconceptions about earthquakes but at Imamura's arguments and analysis in particular. Ōmori challenged Imamura's handling of the historical statistics relating to earthquake frequency, ridiculing the idea that Tokyo was at risk in the near term. If Ōmori's primary goal was to convince city residents to go about their daily lives and not to jump at every passing tremor, he seemed to be going out of his way to declare Imamura's methods and basic premises as deeply flawed (Clancey 2006, 217-8; Hagiwara 1982, 52; Ōmori 1906). It was clear to Imamura and to those working in the field that Ōmori had delivered a very public and pointed denunciation of Imamura's work. Imamura's career and his standing in the field were left badly damaged.

The second episode followed the 1 September 1923 Great Kantō Earthquake. That event left Tokyo and Yokohama in ruins, with large swaths of both cities burned to the ground by massive fires that began almost as soon as the first seismic waves arrived. Parts of Tokyo remained aflame for days, as hundreds of thousands of suddenly homeless refugees sought shelter in city parks and open spaces, or fled the city altogether. The total number of dead and missing likely exceeded 120,000; the disappearance of entire families, neighborhoods and all the records associated with both makes a precise accounting impossible.

In the aftermath of the earthquake, Imamura's career and his reputation were at least partially rehabilitated. He embraced the opportunity the media was quick to offer him to remind the public of his earlier warnings, and to argue that his analyses and predictions had been shown to be accurate (Imamura 1923, 17). From that point on and for the next several years, Imamura was Japanese seismology's most prominent public figure. Promoted to fill the professorship left vacant by Ōmori's death (which happened not long after the earthquake), Imamura wrote regularly for mainstream and scientific journals, and seldom missed an opportunity to engage the press and the public. Imamura's narratives and analyses of the Great Kantō earthquake shaped the public's understanding of the event arguably more than any other single author.

Imamura used his new position and status to argue for a major rehabilitation of Japanese seismology. His plan, which he drafted and ultimately lobbied hard for in Parliament, called for the development of an Earthquake Research Institute (Jishin kenkyūjo), based in Tokyo, with nine remote facilities for observation and data collection (four in the Kantō district, four in Kansai, and one in the Shinano region) (Imamura 1924; Hagiwara 1982, 272). The primary focus of this new institute, and the measuring networks under its control, would be the identification of earthquake precursors. Prediction would be at the center of seismology's new research agenda.

That proposal failed. The government did support the establishment of a new institute in the aftermath of the Great Kantō Earthquake, but instead of the ambitious hub-and-spoke arrangement Imamura had envisioned, one focused on the discovery and exploitation of signs of impending earthquakes, the Earthquake Research Institute inaugurated in 1925 on the campus of the Impe-

rial Tokyo University had a much smaller organizational footprint, and a mission to promote fundamental research in earth science. Prediction, and other forms of "applied seismology," were given low priority (Hagiwara 1982, 90).

Despite these setbacks, Imamura remained one of the most visible spokesmen for seismology and for science more generally long after the fate of the Earthquake Research Institute had been decided. He accepted an appointment in the new Institute, where he served until his retirement in 1930. In public venues he no longer advocated as strongly as he once had for prediction's potential in Japan. In private, however, he continued the quest for clues that would reveal when and where an earthquake was about to occur. Using Imperial Japanese Army cartographic and surveying data, for example, he looked for signs of tilting of the earth's surface and for other indications of increased stress along faults, or within normally stable sectors. By the late 1920s he was certain that the Nankai district faced a very high risk of experiencing a major event. After retiring from the University, Imamura focused his data-collection activities there (Imamura 1933).

Imamura's history and media-savvy approach to finding an audience for his ideas helps explain his willingness to go public with his late 1946 earthquake warnings. A paper he presented at the Imperial Academy in Tokyo in mid-October argued that "it is increasingly felt that the great earthquake just discussed [referring to a Nankai district event] will strike in the near future. This eventuality deserves the utmost attention from an academic standpoint as well as from the standpoint of disaster prevention." (Usami 1982, 21) A few weeks prior to the 20 December earthquake he apparently warned local officials that signs of significant tilting and other surface changes evident in the area meant that they should prepare for the worst (Yamashita 2009, 133-5).

The first Occupation-led inquiries into Imamura's claim started in February. Late that month, SCAP summoned scientists from the Earthquake Research Institute and the Central Meteorological Observatory and asked them directly whether Imamura had predicted the December 1946 earthquake. The Americans and the other Occupation officials involved in these discussions appear to have been skeptical of Imamura's claims, but at the same time curious about Japanese seismology's capabilities. If Imamura had found a way to predict earthquakes, they wanted to know about it (Jishin yochi renrakukai 1979, 13).

Wadati Kiyoo, Hagiwara Takahiro and the other scientists invited to the meeting responded carefully to inquiries about what Imamura had done. Their colleague, they suggested, had been investigating the likelihood of a Nankai earthquake, but because he had not specified precisely when the event would occur, his warning was technically not a prediction, which required a clear statement of when and where the earthquake would strike, and how powerful it would be. That said, Hagiwara, Wadati and the others went on to argue that earthquake prediction was nevertheless worth pursuing. "It was revealed," according to one summary of the meeting, "that earthquake prediction was

considered possible by conducting an extensive program for first order leveling, tiltmeter and tide gauge measurements, and study of earth current."[1] Perhaps not surprisingly, that list is a very close approximation of the methods associated with Imamura's efforts to predict the Nankai earthquake, which were said to have involved the study of "migration of active centers in seismic zone along Japanese coast; analysis of mean sea level variation, and extensive first order leveling program; historical observation of frequency of occurrence and distribution of major earthquakes."[2] Although Hagiwara, Wadati and others in the field were aware of Imamura's activities, no one in either the ERI or the CMO was as actively engaged in prediction-related research as he was. When pressed by the Americans to share what they knew, the field's spokesmen must have been torn; here was a topic the Americans were clearly interested in, and one that Imamura himself was sure to keep in the public eye if he could. And yet it would be fair to say that mainstream Japanese seismology had up until that point not embraced prediction as a prominent research goal. The fact that Imamura's geodetic research was privately supported and not part of any university- or state-funded project points to the persistent gap between institutional seismology's priorities and the investments that prediction-related research would require. The field's spokesmen's rather cautious endorsement of prediction's possibilities was politically expedient in the sense that it engaged the Americans without promising them much.

Beno Gutenberg's arrival in Japan in early June marked a moment that both American officials and Japanese scientists had been waiting for. Gutenberg, who had just the year before become director of the Caltech Seismological Lab, had been asked to advise the Americans on their planned reorganization of Japanese earth sciences. Gutenberg's work was well known in Japan, and to the extent that there was anything positive about American scrutiny, having someone of his stature involved was taken as a good sign by his Japanese counterparts. Seismologist and Professor of Physics at University of Tokyo Chūji Tsuboi was relieved to hear that Gutenberg was coming. Writing to Caltech in February 1947 in what he described as "the first letter which I send to America since 1941," Tsuboi reported first that "My house was burnt and I lost most of my things which are necessary for every day life" before noting that "To-day, I heard that Dr. Gutenberg will perhaps visit Tokio. If this is true, I will be very very glad to see him again."[3]

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1 Report on Development of Research and Liaison Committee for Earthquake Forecasting, 18/11/1947, Topical File, Earthquake, 1945-1952, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

2 Ibid.

3 Letter from Chūji Tsuboi to "Gentlemen," 08/02/1947, Box 4, Folder 1, Papers of Beno Gutenberg, California Institute of Technology Archives. Emphasis in original.

Gutenberg was in Japan for less than a week, and the review on behalf of the Americans one of several projects on his itinerary. He met first with scientists and staff at the CMO accompanied by Chūji Tsuboi as a representative of the ERI, and by SCAP staffers. Tsuboi was later his host at the ERI, where they were joined by the newly appointed director of the CMO, Wadati Kiyoo. These meetings were followed by a conference with SCAP officials, and soon thereafter Gutenberg submitted a formal report. Most of the latter described the relative strengths and weaknesses of the Institute and the Observatory and offered a series of recommendations in support of initiatives to increase collaboration and cooperation across institutional boundaries. The ERI, part of the University of Tokyo, was under the authority of the Ministry of Education. The Ministry of Transportation controlled the CMO, and the Geodetic Survey Institute was part of the Home Ministry. Several other data-gathering facilities operated under still different administrative umbrellas. Gutenberg's modest proposal that a Geophysical Committee be formed to bring together leading scholars from each facility and institute to coordinate research and data sharing stopped well short of calling for a sweeping restructuring or reallocation of resources. Instead, Gutenberg's advice to the Americans was that they leave well enough alone so far as existing institutions were concerned, and that they take steps to help the geosciences community gain access to needed supplies (including journals from overseas).[4]

Gutenberg also addressed earthquake prediction – with some reluctance, judging from the tone of his comments – because his hosts had raised the subject "repeatedly." Gutenberg categorically ruled out the possibility of a successful prediction at present, given the state of the field. "The claims of certain individuals that they can predict earthquakes are not restricted to Japan," he wrote, "but have been disproved thus far in all instances." This was a topic Gutenberg had addressed before, although not in the Japanese context. In late 1935, he and Harry O. Wood co-authored a short article in *Science* in which they responded to press reports in the U.S. that had described recently published research findings as having the potential to predict future earthquakes. Not so, they argued, noting that a valid prediction required considerably more specificity than any examples to date had been able to provide. While not ruling out the possibility that research might someday provide clues that would allow earthquakes to be successfully predicted, they urged caution when it came to bringing untested claims forward. "Any moderately successful method of prediction for scientific testing will be welcomed by all seismologists," they wrote, "but public prediction in the present state of knowledge is nothing short of a menace" (Wood 1935, 220).

[4] Memorandum and Suggestions Concerning Geophysical and Especially Seismological Research in Japan, 1947, Box 14, Folder 22, Papers of Beno Gutenberg, California Institute of Technology Archives.

Gutenberg's comments on the state of prediction in Japan took a similarly cautious stance, but also reflected the range of opinions he had encountered in his discussions with Japanese colleagues. "It was the general consent that such forecast (time of occurrence within at least a week and accuracy of location within perhaps 50 miles)," he wrote, "is not possible at present. A very few views were expressed that the forecast of earthquakes is practically at hand. However the seismologists who have longer experience agreed that it will take a long time before forecast with a sufficient accuracy will be possible."

As dismissive as he was of claims that prediction was "practically at hand," Gutenberg certainly did not rule out the possibility that it might one day be possible. To that end, "every effort should be made to furnish the foundations for such forecasts," he argued, "such as study of changes in level, changes in electric currents in the earth, magnetic elements, in gravity, tilt, and their relationship to the occurrence of earthquakes."[5] It is interesting to note the similarities between the assessment and future research agenda Gutenberg laid out here, and those offered by Wadati and Hagiwara in their meeting with SCAP officials earlier in the year.

One way to read these conversations about prediction, then, is as having helped clarify for the Americans, and perhaps reassert for the Japanese seismological community, the boundaries of the field's skepticism about earthquake prediction. To the extent that Gutenberg's opinions can be thought of as reflecting the consensus of mainstream seismology outside of Japan – a not unreasonable conclusion, at least in 1947 – his visit allowed Japanese seismologists like Wadati, Tsuboi and their colleagues to situate themselves within that broader consensus. At the same time, their doubts about the claims of Imamura and others confident that prediction was within reach did not prevent them from seizing an opportunity to go against the field's trajectory up to that point, and make the pursuit of prediction one of its central features.

4. The Earthquake Prediction Research and Liaison Committee

By the end of the summer of 1947 earthquake prediction was a very visible component of Japanese seismology's mission. The "Earthquake Prediction Research and Liaison Committee" (Jishin yochi mondai kenkyū renraku iinkai), which met for the first time in August, was the nation's first state-sanctioned attempt to coordinate and support inquiries into forecasting and prediction. It functioned by bringing together representatives of facilities and university departments with active seismology research or data-gathering pro-

[5] Ibid.

grams, including Wadati Kiyo (CMO), Takahashi Ryūtarō (ERI), Tsuboi Chūji (Tokyo University), Sassa Kenzō (Kyoto University), Nakamura Saemontarō (Tohoku University) and others; Imamura was one of several scientists invited to participate "as authorities in their fields."[6] The proposal to form the committee had originated with Wadati within a few days of Gutenberg's visit to the CMO in early June. In a letter to a liaison officer at the 43rd Weather Wing, Wadati had asked for the Americans' help developing a research initiative around earthquake forecasting research. Less than a week later, the Americans directed Wadati to "take immediate steps to begin organizing a committee consisting of interested Japanese scientists and organizations for coordinating research on earthquake forecasting problems."[7] By the end of the summer, the committee had already identified a half dozen research initiatives that merited support.

And therein lay a problem. Committee members proposed, among other projects, the construction of ten new tidal gauge stations, nine rhombi (large survey sectors used to track vertical and horizontal displacement on the surface through precise measurements of changes in the distances and relative altitudes between points on the rhombus), improvements to a number of existing geodetic facilities, and the purchase of a large number of sophisticated tiltmeters and other measuring devices. While not unreasonable given the committee's mission and their informed understanding of what research on earthquake prediction would require, the projects' combined price tag came as quite a shock to the Americans. One estimate put the initial outlay at between 15 and 20 million yen, much more than SCAP was willing to authorize at a moment of general belt-tightening and budgetary restraint. The entire Ministry of Education research budget in 1947 was just under 72 million yen (Nakayama, Gotō and Yoshioka 2001, 278). Within weeks of having taken the first steps toward collaborative research on earthquake prediction, the Americans sent a clear message that the Japanese were free to pursue the initiative only so long as it did not require additional resources. The Committee's mandate to coordinate research and share information remained, but the proposals to fund new measuring sites and facilities were put on hold.

This setback is reminiscent of Imamura's experience after the Great Kantō Earthquake, when his efforts to launch a large-scale survey and prediction research effort failed, at least in part because of concerns over its enormous cost. And yet the circumstances in 1947 were obviously different from those in

[6] Preliminary Meeting on 11 August 1947, of the Research and Liaison Committee for Earthquake Forecasting at the Central Meteorological Observatory," 12/08/1947, Topical File, Earthquake, 1945-1952, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

[7] Meeting of Research and Liaison Committee for Earthquake Forecasting on 29 August 1947, 18/09/1947, Topical File, Earthquake, 1945-1952, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

1924; the committee's very existence testified to earthquake prediction's emerging legitimacy as a field of research, something that had certainly not been the case when Imamura was lobbying on his own for an expanded observational network. The arguments against funding the committee's proposals in 1947 had rested not on concerns about whether they lacked scientific merit. The physics seemed reasonable enough; the fiscal picture much less so.

Also different was the number of scientists and institutions involved in earthquake prediction. Twenty years earlier Imamura had been the only seismologist making claims in public about prediction's efficacy. The new committee, in contrast, included many of the country's leading authorities in seismology and related fields, and representatives of most of its premier research institutions and academic departments. Although, as Gutenberg had noted, opinions differed among these scientists as to how close they were to being able to make valid predictions, the consensus was clearly in favor of moving forward with prediction-related research. Some of the enthusiasm for the committee's goals was almost certainly tied to a belief that American support was the key to obtaining funding; cooperation across otherwise fiercely guarded institutional and functional borders may have been a price worth paying if it meant access to more and better resources.

These factors, along with the broader social transformations underway in surrender's wake, help provide some context for the decisions by Sassa Kenzō, Nakamura Saemontarō and others to issue public warnings – based on their findings from ongoing research projects – that damaging earthquakes would strike soon. The first in the series of four different warnings was made in 1947, the last in 1949. Each prediction relied on methods specific to the researcher involved, each located the area of greatest hazard in a different part of the country from the others, and each was widely reported by the media. None of them came true.

5. Predicting Earthquakes: 1947-1949

Early signs that earthquake prediction was entering a new phase came in August, when the popular daily newspaper the *Nihon keizai shinbun* (*Japan Economic News*) featured side-by-side articles by Imamura Akitsune and K. Sagisaka, head of the Seismology Section at the Central Meteorological Observatory, each addressing this question: "Can Earthquakes be Foretold?" (Nippon Times 1947a) Imamura not surprisingly argued that they could. He described "observable delicate movements and inclinations of the ground, changes in the electricity and magnetism of the earth, and the muddle state of water underground" as "forebodings" of an imminent event. "By observing these changes," he argued, "one can foretell an earthquake several hours, or days, or months in advance." Relating his own efforts from as early as 1929 to warn authorities of

the risk to the Nankai district, including his October 1946 lecture and the letters he dispatched to local authorities just prior to the 1946 Nankai earthquake, Imamura offered seemingly compelling evidence of how this could be done.

Sagisaka took a much more conservative position. While he did not address Imamura's claims, or any specific predictions, Sagisaka pointed out first that there were dozens if not hundreds of small earthquakes in Japan in any given month, the implication being that such large numbers prevented identification of those which might be precursors from those that were not. Nor, Sagisaka noted, had other approaches been productive: "We are carrying on intensive studies in the inclination of the ground, the electricity and magnetism of the earth, and the change in the speed of seismic waves," he acknowledged, "but we have yet to possess ourselves of materials that can be relied upon to foretell an earthquake" (Nippon Times 1947a).

Little in this exchange would have been surprising to members of the Earthquake Prediction Research and Liaison Committee, which held its first meetings in August – both Imamura and Sagisaka were among its members, after all – but the article's appearance does mark an interesting moment in terms of how prediction was being framed for public consumption. The juxtaposition of the two positions – one insisting that earthquake prediction was an impossibility, and the other that it was already at hand – did more than just draw attention to an ongoing debate within the scientific community. Where one stood on the question of whether earthquake prediction was possible or not had obvious implications for how to prioritize funding for seismological research, but more importantly that distinction also forced scientists and the public to begin to think through the implications of both sets of claims.

A consensus that earthquake prediction was categorically impossible at current levels of understanding and technical expertise meant that there was little that seismologists – or the Earthquake Prediction Research Committee – could do to protect the nation that they were not already attempting. More research and careful study lay ahead, goals well within the Committee's remit to support and in keeping with the expertise of its members. Assertions that meaningful predictions were possible, on the other hand, had the potential to raise any number of questions about the way forward, among them several about the role that the scientists themselves would play in this new environment. Who would decide which warnings, if any, to share with the public, and what information would those warnings convey? What happened once a prediction was made public? What would scientists have the public and policy makers do once they knew when and where a damaging earthquake was expected to strike? As much as the Committee's leadership may have wished to avoid dealing with questions such as these, their earliest meetings were hardly over before they were forced to deal with the first of what would become a cluster of highly visible prediction "events."

Most of the earthquake predictions the Committee encountered over the next few years originated with Committee members, not with outsiders or non-specialists. The first of its members to blur the line between prediction as a research problem and as a set of practices with public ramifications was Kyoto University Professor of Geophysics Sassa Kenzō. Sassa shared his concerns about the increased likelihood of a major earthquake in the Kansai area (a region that included the major metropolitan centers of Osaka, Kyoto and Kobe) with the Committee in August. Sassa had worked for several years on studies of surface deformation and tilting, and had installed a variety of precision tilt-meters and other instrumentation at locations throughout the Kansai region in efforts to track such changes over time. "Earthquake prediction was never realized," Sassa suggested to the committee, "because of the lack of precise geophysical measurements in a station network in the vicinity of an earthquake prior to its occurrence."[8] It was his belief, in other words, that displacements in the earth's surface preceded earthquakes, and that careful measurements would reveal those changes in time to provide warning of an impending seismic event. This was not a new argument, since Imamura had made similar ones before about the Nankai earthquake, and the Committee's proposals for an expanded tidal gauge network and geodetic rhombi relied on the same principals and assumptions. Two things set Sassa's approach apart from the general work of the Committee, however. One was that he was drawing quite specific conclusions about the short term risk of a major earthquake in the Kansai area on the basis of data already in hand. The other was that he shared his concerns directly with the public.

Sassa offered his take on prediction's potential in public lectures, edited versions of which appeared in September as a thirty-page pamphlet provocatively titled *When Will the Kinki Earthquake Occur*? (Kinki jishin wa itsu kuru ka) (Sassa 1947) Although the text provided readers with an introduction of sorts to seismology and earthquake mechanics, Sassa's main topics were prediction and hazard mitigation. These were not unrelated, in that Sassa sought to impress readers with the importance of understanding the risks they and their communities faced while at the same time providing some insight into the steps they (and the government) should take to protect themselves from harm. A complaint Sassa returned to repeatedly was that neither the public nor officials were doing nearly enough to plan ahead for the calamities that were all but certain to occur. The costly rebuilding then underway in the aftermath of the Nankai earthquake, he pointed out, was taking place without any regard for the fact that the region was still seismically active. Millions of yen would be spent on projects that would just have to be rebuilt again when the next earthquake struck. Sassa's point was that it was altogether possible to significantly reduce

[8] Ibid.

the hazards to communities by improving building practices, or by drawing in other ways on what scientists already knew about earthquakes to create a better informed and thus safer citizenry. Money that had gone toward the war effort could now be:

> [U]tilized for public welfare work, such as a long range program for earthquake-proof construction as a national project. This would eventually mean saving many human lives, an immeasurable amount of property and wealth. However, the most important step to be taken now, is to popularize knowledge concerning the nature of earthquakes and practical methods for preventing major destruction (Sassa 1947, 2).

A corollary to Sassa's insistence that more attention be paid to how to defend against earthquake hazards was his explanation of why he and scientists like him were so certain that the risks were real and persistent. On his way to making a specific point about the risk to the Kinki district, Sassa offered a more general and vivid argument about earthquake mechanics. He described Japan, and the main island of Honshu in particular, as subject to massive forces that were pushing some parts of it ever so slowly in one direction, and other parts of it in another. Sassa asked readers to imagine a line drawn from Ise Bay to Wakasa Bay, bisecting Japan's main island through the Kansai district. The area west of that line, including Kyoto, Osaka and Kobe, was being pushed northwest; to the east of the line, the main island was shifting toward the southeast. "It signifies," Sassa wrote, "that the force which formed the Japan island arc is still functioning, and causing these earthquakes. It is reasonable to conclude that the severe earthquakes which have been occurring in this area for the past several hundreds of thousands of years will still continue to occur" (Sassa 1947, 7).

Earthquakes happened when the strain that had been built up in the earth's crust along boundaries like those Sassa had described, was released. The small, frequent resolutions of tension that produced tremors unnoticed by average citizens were one marker of these ongoing larger processes. But, Sassa pointed out, records going back to the seventh and eighth centuries indicated that the Kinki region was subject to regular (but not necessarily periodic) major earthquakes, suggesting that something about the underlying geological structures allowed strain to build over long periods of time, only to release it in sudden, cataclysmic events. "The energy thus stored between occurrence of major earthquakes," Sassa wrote, "is of the order of a thousand to a hundred thousand of that of an atomic bomb" (Sassa 1947, 4). His own calculations led him to conclude that despite the two recent earthquakes in the region – in 1944 and 1946 – unreleased strain was still present, which meant that the district was still in a seismically active phase. It is striking to think that Sassa chose to use a comparison with the atomic bombings of Hiroshima and Nagasaki – in 1947 still very recent events – to convey to readers something of the power of the forces at work nearby.

Having given readers reason to think that there were steps they could take to mitigate future harm, and reason to think that the risks were real and significant, Sassa still had to somehow address the question posed in the pamphlet's title: When would the Kinki earthquake strike? The short answer was that scientists were not sure, at least not sure enough to offer an unqualified prediction. Sassa described for his readers the different indicators that he and scientists like him were using as they tried to get closer to being able to actually predict an earthquake: measurements of horizontal and vertical crustal displacement, of changes in magnetism and electric currents, and in well water turbulence were among the ones cited. Sassa was careful not to create the expectation that predictions were or could be 100 percent accurate, and went so far as to point out that "[i]n our present society, earthquake forecasting would do more harm by unnecessarily exciting mass fear rather than promoting the undertaking of logical precautionary measures." Sassa clearly wanted to keep the focus on the pursuit of "logical precautionary measures" as best he could, while at the same time establishing a reasonable degree of heightened concern in his target audience.

Of the various earthquake warnings that surfaced that fall and into the next year, Sassa's published work and public statements were arguably the most balanced and thoughtful. In addition to highlighting risks and introducing predictive methods and technologies to a wide audience, they also pointed toward policies that could help mitigate against potential harms. Sassa, for example, gave detailed, practical instructions for surviving an earthquake – which parts of the house were safest, how to fight fires, and so on – bundled with calls for better public policy in light of what they knew of the nation's own experiences, and the ongoing threats it faced. Referencing the devastating fires that followed the Kantō earthquake, Sassa highlighted the failures of planning and behavior that allowed the conflagration to spread, concluding that "It isn't as if such catastrophes were unavoidable. They could have been avoided, but were not." Careful preparation would go a long way toward preventing anything similar from happening when the next earthquake struck.

Over the next several months, the nuanced tone Sassa might have hoped to preserve in discussions of what prediction was and what it was not, and what people ought to be thinking about most in light of the risks they faced, was lost. Two developments established the tone and focus of the public discourse on prediction. First, the *Mainichi* newspaper reported on 11 September 1947 that Seiichi Yamaguchi of the Home Ministry's Geographical Research Bureau had predicted that a major earthquake would strike the Kantō district within the next three or four months – he had apparently named either December 1947 or January 1948 as the likeliest times (Mainichi shinbun 1947).

The basis for his claim was his observation that the sea level as measured at the western tip of the Miura peninsula, not far from Tokyo, had declined rapidly in June, July and August. As Yamaguchi pointed out to reporters, similar changes in sea level – which indicated vertical displacements in the land at

water's edge – had been reported around the time of the Kantō earthquake, and prior to the 1946 Nankai earthquake too. Unless the levels returned to normal, Yamaguchi warned, a major earthquake could occur in the very near future.

The second development was Sassa's own announcement in December 1947 that he had spotted anomalous and worrying results from instrumentation installed in an unused railway tunnel on the outskirts of Kyoto. Although neither Sassa's initial public foray in September nor Yamaguchi's announcement that same month had generated much press coverage at the time, Sassa's statement in early December triggered interest in both predictions. The *Asahi* was the first to break the news of the warning Sassa had delivered to local police officials on 5 December 1947, which read:

> There has been an abrupt change in the indication of the tiltmeter and dilatometer which were set up in Osakayama as the network for the prediction of earthquakes. Precaution is especially necessary now from the standpoint of the prevention of disaster. It is urgently required that a committee for the earthquake be selected as soon as possible (Asahi shinbun 1947).

The measuring devices had been in place in the tunnel since August. According to Sassa, beginning in mid-October they had begun to record an accelerated rate of contraction of the earth's surface along an axis running from the southeast to the northwest. Sassa interpreted this to mean that much more strain than normal was accumulating in the district, and that therefore the risk of a catastrophic release of that tension was also much higher than normal. Nowhere in the article is Sassa cited as having named a date, or even a time frame, for when the earthquake he feared might strike.

The day after the article appeared in the *Asahi*, the *Yomiuri* began its own coverage with a story that brought together Yamaguchi's prediction of a few months earlier of an imminent Kantō earthquake with Sassa's cautions about the next big quake in the Kansai district. The report explained how anomalous readings from devices designed to precisely measure changes in the earth's surface had led scientists in each instance to issue their respective warnings. The "rumor on the forecast of the occurrence of the great earthquake has prevailed based on the movement of the earth crust which has become more active all over the country," according to SCAP's translation of the article, "with the result that the restless feelings of the postwar public are further intensified" (Yomiuri shinbun 1947).

The distinction between legitimate warning and rumors, and between the responses the scientists had hoped to provoke and the actual reactions of the citizenry came into sharper focus over the next several weeks. References to the "restless feelings of the postwar public" were replaced by descriptions of outright panic, "widespread repercussions and fear," and reports that the residents of at least one community in the Kansai district had already begun to flee their homes and abandon their village altogether, fearing a repeat of the devastating December 1946 Nankai quake (Nippon Times 1947c). A small but no-

ticeable earthquake north of Osaka on 10 December heightened the sense of urgency Sassa had sought to convey in his warning to local officials. That there was a degree of disconnect between what Sassa had thought he was saying (or would later claim to have said), however, and what local officials were hearing, also became clear. "We were told by Dr. Sassa that an earthquake would certainly happen," reported the Chief of the Kyoto Prefectural Police, "consequently we are hurriedly organizing counter-measures."[9] In the context of reports of pre-emptive evacuations, fishermen pulling their nets from the water, and the Chief's definitive statement about the need to act quickly, it would appear that many had understood Sassa's warnings as a call to immediate and definitive action.

Sassa's stated goals for issuing the December warning – to alert the public to the increased risk, and to make officials and average citizens aware of the steps they could take to mitigate the harm that an earthquake might cause – were in tension almost from the start not just with the public's jittery response, as we have seen, but also with those of his colleagues on the Earthquake Prediction Research Committee. A similar set of tensions were evident following Yamaguchi's statements warning of an imminent earthquake in the Kantō district, and later in the wake of prediction events in 1948 and 1949.

One set of tensions took the form of debates over what scientists could do with the data to which they had access. By late 1947 the Committee and to some extent the broader community of earth scientists in Japan had agreed upon a shared definition of how predictions might eventually be produced, and had developed lists of the different measurements that together might yield viable predictions. That list included the same tools that both Sassa and Yamaguchi had deployed and read, and which had prompted them to issue their warnings. In Yamaguchi's case, the instruments in question were tidal gauges; for Sassa, tiltmeters and strain gauges. The questions to be addressed in the wake of the announcements by Sassa and Yamaguchi were therefore less about the potential value of the data – the connections to earthquake prediction having already been established – than to how to interpret that information, and whether it met the criteria for prediction.

In a pattern that was established soon after Yamaguchi's pronouncements in September, Wadati Kiyoo became the go-to scientist for reporters in need of an official response to earthquake predictions and the warnings attached to them. Wadati's credentials were impeccable. Internationally, his seminal work on seismic activity deep in the earth's crust established the existence of what would eventually be known as Wadati-Benioff Zones. Locally, as both chair of the Earthquake Prediction Research and Liaison Committee and Director of the

[9] Stars and Stripes, 11/12/1947, typed copy. Topical File, Earthquake Research Institute, 1946-1951, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

CMO, Wadati spoke as a recognized national authority on earthquakes and as a senior representative of the state's own research apparatus. Wadati was also consistent; while never going so far as to question his colleagues' judgment outright, he could be counted on to cast doubt on findings that relied on limited evidence, as he viewed it, and thus to reassure the public that their worst fears would likely not come true. In early December, in the same article that linked the predictions by Sassa and Yamaguchi, Wadati suggested that "It can't be definitively determined whether such disparate phenomena are actually indications of an earthquake or not" (Yomiuri 1947). A few days later a long piece by Wadati in the *Yomiuri* newspaper explained the difference between foreknowledge of an earthquake, described as information that a major earthquake was likely, without being able to specificy a time or place, and forecasting, which Wadati equated to predicting an earthquake much as one would the weather, within very narrow ranges of time and place (Wadati 1947). Wadati's opinion was that such forecasting might be possible to some degree at some point, but certainly not at the present time. He was much more optimistic about "foreknowledge," but asserted that better equipment was absolutely essential before even that degree of predictive practice could be achieved. "At present," he wrote, "the earthquake research equipments are too poor to foretell the occurrence" of an event. "Plainly speaking, at the present stage of our science, it is impossible to foreknow exactly the place, time and scale of an earthquake."[10]

Wadati never came right out and said that Yamaguchi and Sassa were wrong, and instead implied that he shared the confusion he imagined the public must be experiencing. How could Yamaguchi and Sassa be right if, as Wadati suggested, the science didn't support their claims? Here Wadati did offer a partial answer. "Sometimes," he reflected, "seismologists may conceive the probability of a large earthquake from his researches and observations, and publish it as their own responsibility." When that happened, concluded Wadati – and here his word choice is perhaps deliberately ambiguous – he urged people to "be vigilant." Was he calling on them to heed the warnings that such seismologists might offer and take care against the hazards they highlighted, or was he calling on the public to be skeptical of such claims, and to guard against being misled?

Wadati's cautions reflect a second set of tensions made evident as predictions surfaced in 1947 and 1948. These tensions appeared as debates among Earthquake Prediction Research Committee scientists about their individual and collective responsibility to share their findings with the public. Wadati and other Tokyo-based scientists belonged to one camp, and sought to err on the

[10] "It Is Said That an Earthquake May Take Place," typed translation from Yomiuri shinbun, 15/12/1947. Topical File, Earthquake Research Institute, 1946-1951, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

side of caution. Because "accurate earthquake prediction was still not possible with present theoretical knowledge, observational methods and data," they argued, "scientists should not make guesses which would disturb the public or lead them to be alarmed."[11] In December, Wadati put several proposals before the committee, including one that would have required its members to submit predictions or warnings to the group for review before making them public. That proposal failed. Wadati's suggestion that the committee draft a white paper that explained earthquake prediction to the public also ran into opposition; members feared that the press would garble their message, or twist it into something sensationalistic (Jishin yochi renrakukai 1979, 20-2).

A second cluster of scientists – including Yamaguchi, Sassa, and Nakamura Saemontarō – held firm to the idea that they owed it to the public to issue warnings when the evidence merited it. A summary of committee discussions on this subject in January 1948 has them asserting that "it was a scientist's duty to make practical use of his knowledge for public welfare."[12] The decision to announce findings, even those that had the potential to be disruptive, was theirs to make. Similar statements by Sassa appeared in print in mid-December, when it was reported that he had criticized "seismologists who withheld news of possible earthquakes because they "weren't sure.' It is the duty of these men, he declared, to warn the people."[13]

At the same time, Sassa was not uncritical of the press, and was wary of how the public had reacted after he had issued his warnings in December. In both news accounts and then at the January meeting of the Committee (the first such session to attract an audience of journalists), Sassa insisted that he had never actually predicted that an earthquake was imminent, as some press outlets had claimed. What he had done, he said, was to call on local authorities and the public to exercise due caution against the possibility of one occurring sooner than might have been expected, given what seemed to him to be unexpected changes in the behavior of the region's topography. Complaining that "his views had been 'distorted and misconstrued,'" all he had wanted was for the public to practice better fire prevention methods, and to reinforce those buildings most at risk of collapsing should an earthquake strike. The wild rumors and panicked citizens were the media's doing, not his (Nippon Times 1947b; Jishin yochi renrakukai 1979, 19). Yamaguchi, somewhat more quickly than Sassa, had also argued that the press had misconstrued his meaning, and that he

[11] Meeting of Research and Liaison Committee on Earthquake Forecasting on 23 January 1948, 19/02/1948, Topical File, Earthquake, 1945-1952, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

[12] Ibid.

[13] Stars and Stripes, 16/12/1947, typed copy. Topical File, Earthquake Research Institute, 1946-1951, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

had not intended his announcement to be taken as a prediction that an earthquake was imminent.

The combination of Wadati's public reassurances, and the statements by both Yamaguchi and Sassa that neither had actually predicted an earthquake, seems to have prevented signs of unrest in the areas implicated in their warnings from growing worse. No additional reports of hurried flight from at-risk villages surfaced, no damaging earthquakes occurred, and media interest waned. Although committee members remained divided around questions of their responsibilities to the public and how to interpret their research findings, as of January 1948 the atmosphere of crisis appeared to have passed.

It was not long before another prediction repeated the cycle of public unrest and expert intervention. One of the papers given at the June 1948 meeting of the Committee introduced recent work by Inoue Win, of the CMO, on fore- and aftershocks associated with large earthquakes. Inoue had been studying "the propagation of earthquake stress or strain waves," in part by looking for relationships between the timing and the longitude and latitude of seismic activity throughout Japan. He soon realized that the interactions of the waves seemed to correlate over time with when and where large earthquakes would strike. Preliminary work using data from events many years past seemed to successfully "predict" earthquakes that were known to have occurred, suggesting that these same methods could be used for earthquakes that were still weeks or months away from happening. At the meeting at which he presented his work, Committee members showed polite interest, and Inoue was encouraged to come back with more evidence – his colleagues were especially curious to see how well this approach did at predicting, retroactively, a wider range of past earthquakes.[14]

Inoue's presentation was unusual in part because it offered an approach to prediction that was not driven solely by the hunt for elusive precursors; his theory that strain waves propagated earthquakes in patterns that possessed a certain mathematical elegance was a far cry from the comparatively primitive tools the field had been relying on up to that point. What ultimately made the presentation memorable, however, was not so much the promise of the theory but instead Inoue's rather offhand response to what at the time seemed to be a not very serious question. Asked by one of the committee members where his calculations predicted Japan's next major earthquakes would occur, Inoue answered that Fukui, a city (and prefecture) on the Japan Sea coast, and Chichibu, a town (and district) west of Tokyo, were likely locations. He was not pressed to offer additional details, and neither Inoue nor others present seem to

[14] Meeting of Research and Liaison Committee for Earthquake Forecasting, 9 June 1948, 19/06/1948, Topical File, Earthquake, 1945-1952, Records of Allied Operational and Occupation Headquarters, World War II, 1907-1966, Record Group 331, National Archives at College Park, College Park, MD.

have given the exchange much thought. SCAP's notes on the meeting make no mention of it.

A little more than two weeks after Inoue's presentation, Fukui suffered a massive earthquake, the nation's deadliest since 1923. More than 3,700 people were killed, and some 20,000 reported injured. Fires in the city burned for five days before being brought under control. News reports that Inoue had predicted the Fukui earthquake appeared not long after, as did warnings that he had identified Chichibu as next in line to be struck.

The media frenzy and expressions of dismay by Chichibu's residents that followed were on a much larger scale than the turmoil that had accompanied the Kantō and Kansai predictions of only a few months before. Speaking to a packed auditorium at the University of Tokyo in early July, Inoue tried very hard to present his work as speculative, and his findings as preliminary. When pressed during a question-and-answer session at the end of his talk, however, Inoue again specified the location (the Chichibu mountain range), the timing (late August or early September) and the severity (not very – perhaps strong enough to collapse a few homes) of the nation's next earthquake (Asahi shinbun 1948; Jishin yochi renrakukai 1979, 23). Chichibu residents did not respond well to this news; some fled outright, while others desperately sought advice from officials and scientists about what steps they could take to defend their communities and homes. Inoue's announcement reportedly forced the governor of Saitama to cut short a trip to Fukui, where he had been inspecting the effects of that district's recent earthquake, in order to begin preparing his own prefecture for a similar calamity.

It is possible to overstate the Committee's role in calming the waters as the "deadline" for the Chichibu event approached, not least because the most detailed accounts of how the press and the public were eventually reassured that Inoue had been mistaken are themselves written by Committee members. According to one such account, after attempts by several CMO scientists to replicate Inoue's results failed, suggesting that the relationship between his "prediction" and the Fukui earthquake was purely accidental, Inoue himself readily acknowledged the need for further study, and was more than willing to admit as much to the press and public. The more Inoue tried to explain that he had been mistaken, and that Chichibu was almost certainly not at risk (at least not because of the mechanisms that Inoue's hypothesis had pointed toward), however, the less the press seemed willing to believe him. At a closed-door meeting of the Committee in late July, Inoue again agreed with his colleagues that there was much more work to be done, but insisted that he simply could not get the press to believe him when he tried to explain that his comments about Chichibu had been a mistake. He appealed to the Committee, therefore, to speak on his behalf.

At least some members of the Committee were happy to do. Chairman Wadati used the blackboard to draft a statement, revising the text with input

from other members, and called a press conference for a little after noon. "Committee member Inoue today made it clear," Wadati said, "that he shares the Committee's findings that his statistical methodology is at present not very effective in terms of earthquake prediction." Noting that Inoue's work had many merits, and that the Committee had urged him to continue with it, Wadati suggested that perhaps it would be best if he shared the elements related to earthquake prediction with the public only after further, thorough review (Jishin yochi renrakukai 1979, 23-4; Hiroi 1995, 211-6).

As before, these interventions by the Committee coincided with diminished anxiety in the communities that had been named in the prediction. Once August and September passed without an earthquake in the Chichibu district, the Committee's foresight and caution seemed all the more justified. (The first significant postwar earthquake in the Kantō region did not occur until 1987, and was centered in Chiba prefecture, east of Tokyo.)

The final episode in this cluster of predictions had its origins in the aftermath of the Fukui earthquake. In early 1949, Committee member and Tohoku University Professor Nakamura Saemontarō announced to the press that Niigata city should expect a major earthquake within the next one to two months. (Niigata had a population of around 300,000 at the time.) Nakamura had spent part of 1948 after the Fukui earthquake engaged in careful studies of terrestrial magnetism all along the Japan Sea coast, and was alarmed by anomalous readings in the vicinity of Niigata. When the changes he had been observing in the district abruptly stopped in February 1949, Nakamura interpreted those results – based on historical precedent, he claimed – as precursory to an imminent earthquake in the area (Jishin yochi renrakukai 1979, 24).

The results of his announcement were in keeping with past experience. The Niigata prefectural government dispatched the deputy governor to Tokyo to consult with the Committee, the governor advised citizens to prepare, just in case, and extra building supplies were made available to city residents anxious to reinforce their homes. In late March, Nakamura was asked to report on his methods and findings to the Committee. They were not well received; many of those present at the meeting found fault with Nakamura's approach, and disagreed even more strongly with his conclusions. It may not have helped Nakamura's standing with the committee that back in July 1948, even as concerns over Inoue's prediction were playing out in the press, a quote from Nakamura had appeared in the *Yomiuri* newspaper essentially calling out his colleagues for holding on to old-fashioned, out of date ideas about prediction. "A long time ago, it was true that seismologists didn't really have anything worth saying to the public about earthquake prediction," Nakamura stated, "but even now that barrier still exists, and many people believe that is better not to say anything about predictions**.** Personally, I think that time has passed. I have no use for seismologists who won't provide forecasts, or get angry when one is produced" (Nakamura 1948).

Although Nakamura pushed back hard in defense of his work and his decision to warn the public, his colleagues on the Committee took the unusual step of issuing a press release critical of both Nakamura's research and his announcement. "In seismology's present state, as has been stated many times, it is impossible to make a definitive earthquake prediction," the Committee stated.

> The recent Niigata Earthquake Theory was in the form of a caution that emerged from Professor Nakamura's ongoing research, and yet, again referring to the state of seismology right now, it is the opinion of most of the members of the Committee that it would be premature to consider his caution as equivalent to an actual earthquake prediction (Jishin yochi renrakukai 1979, 24).

6. Conclusion

The Earthquake Prediction Research and Liaison Committee stopped doing anything noteworthy not long after the resolution of the Niigata predictions, and for many years thereafter the nation experienced neither major earthquakes nor well-publicized predictions. Many of those involved in making or responding to these early episodes of predictions, however, did go on to play key roles in the construction of Japan's next, more sustained attempt at organized, state-sanctioned earthquake prediction research.

The 1962 publication of *Earthquake Prediction: Current Status and a Plan for Development* (*Jishin yochi: Genjō to sono suishin keikaku*) (Jishin yochi keikaku kenkyū gurupu 1962) marked the return of prediction as a priority for the field, and of a deliberate effort to avoid the pitfalls of the late 1940s. That document showcased a consensus among Japanese seismology's leading scholars that with adequate research support, they would soon be able to predict seismic events. The "Blueprint," as the report quickly came to be known, outlined the steps that researchers and the state needed to take in order to make earthquake prediction a practical reality. Perhaps not surprisingly, these steps were quite similar to those that had been central to the plans these same scientists – Wadati Kiyoo, Tsuboi Chūji, and Hagiwara Takahirō among them – had outlined in 1947. This time around, however, the scientists both cultivated political alliances that began to provide them with the resources they had long sought, and worked very hard to regularize and manage how predictions and warnings would be assessed and shared with the public.

The June 1964 Niigata Earthquake, and the onset of the Matsushiro Cluster Earthquakes the following August further focused the attention of policy makers and seismologists; the formation of the Coordinating Committee for Earthquake Prediction (Jishin yochi renrakukai) in April 1969, chaired by Hagiwara Takahirō, was one outcome of an emerging alliance between scientists in leading research universities and policy makers in the Ministry of Education and other state agencies, around prediction's potential (Jishin yochi renrakukai

1979, 35). A telling difference between this committee and its 1947 predecessor is that "research" disappeared from the language it used to describe itself to the public. One can read many things into this absence, but a reasonable conclusion would be that by 1969 it had been decided that the time for emphasizing research had passed, and that the committee's preferred mission was instead the actual practice of prediction (Geller 2011, 89).

The 1978 Large-Scale Earthquake Countermeasures Act – often identified as the Coordinating Committee's crowning achievement – makes it clear that at some point the reliability and utility of earthquake prediction had become givens (Ishibashi 1982). The Act's underlying premise was that earthquake prediction was possible in the present; it allowed for the designation of districts known to be at high risk for a major event, put in place protocols for the evaluation of precursors and other signs indicative of an imminent earthquake, and both established clear channels of communication for the dissemination of warnings and granted the state sweeping powers to shut down transportation networks, public gatherings, and otherwise act to keep people out of harm's way. One can certainly see in the Countermeasures Act the culmination, for better or for worse, of more than thirty years of iterative negotiations between earthquake prediction as a technical practice and prediction as an intervention in everyday life. At the very least, the Act provided seemingly definitive answers to questions that had confounded the Committee in the late 1940s, among them how to decide when a prediction was merited, who spoke for the field, and what could be done to manage the disruption and fear that such an announcement might provoke.

The Act has not yet been tested. Its procedures and the bulk of the predictive efforts associated with them target the so-called Tōkai earthquake, a much anticipated and feared event that if it happens will likely cause tremendous harm to Nagoya, Shizuoka and many other communities in some of Japan's most heavily urbanized areas. As noted at the beginning of this article, doubts have begun to mount about the commitment of attention and resources to this single district and methodology and about the assumptions that underpin those commitments, but there are as yet few indications that Japan's earth scientists or the state agencies that support their work plan to turn their backs on prediction any time soon.

One observation that follows from thinking about the place of the late 1940s cluster of warnings in the longer history of the earth sciences and earthquake prediction in Japan is that changes in how the field and the state related to prediction do not seem to have been closely tied to shifts in how scientists themselves understood earthquakes. The activities around prediction in the 1940s and again in the early 1960s were not directly associated with the introduction of new theoretical frameworks for explaining seismicity. Later, even the acceptance of plate tectonics theory by the seismological community in

Japan over the course of the 1960s does not appear to have changed how practitioners approached prediction so much as it reinforced existing discourses.

A second observation is that it took a long time for research into earthquake prediction and hazard mitigation policies based on that research to acquire scientific and political legitimacy. One might assume, given its prominence in recent years, that prediction had long been at the core of how the state and seismology chose to respond to the very real hazards that earthquakes posed for Japan. This is not so. Though many of the basic principles informing present day efforts at prediction were spelled out in Imamura's 1924 proposal to remake seismology's research agenda, neither that proposal nor the agenda set out more than twenty years later by the Earthquake Prediction Research and Liaison Committee triggered lasting changes in how earth scientists and policy makers dealt with earthquake prediction. Fifteen more years passed before the 1962 "Blueprint" described a way forward for the field in which prediction played a meaningful role, and it wasn't until 1978 that the Large-Scale Earthquake Countermeasures Act tied earthquake prediction to hazard mitigation efforts.

As earth scientists, policy makers, and the Japanese public consider the hazards they face in the present day, it is worth wondering whether prediction's idiosyncratic past has been a barrier to a more open discussion of its future role. Although the attempts by Sassa and his colleagues to make prediction work in Occupied Japan did not succeed, their efforts, like those of Imamura before them, have become part of a narrative that celebrates their tenacity and foresight, and connects them to the brighter history of recent decades, in which earthquake prediction has been central to the government's hazard mitigation policies and in which research funds for those projects have flowed freely (Nihon jishin gakkai 2013). Moving away from prediction as earth science's most valuable contribution to the public welfare entails at some level a challenge to that by now well established narrative. Focusing on earthquakes that didn't happen is, perhaps, one useful approach to a rethinking of that history.

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